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THE EFFECTIVENESS OF CONSERVATIVE TREATMENT IN JUVENILE KNEE OSTEOCHONDRITIS DISSECANS – A SYSTEMATIC LITERATURE REVIEW

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The purpose of this thesis is to present a compilation of information about juvenile knee osteochondritis dissecans (JOCD) and to conduct a systematic literature review. The thesis will review and analyse previous studies to give an overview and determine what is the healing rate of stable JOCD lesions with conservative treatment.

The first half of the thesis gives an overview of knee joint, JOCD itself and its treatment. The second part focuses on literature review regarding stable JOCD lesion healing rate with conservative treatment. The search for free full access articles was made using three online databases: PubMed, ScienceDirect Journal and EBSCO aimed to find the most recent articles (published 2000 or later). Three articles fulfill named criteria that is analyzed in detail at latter part of the thesis.

All three studies showed that stable JOCD healing has positive outcome when treated conservatively. Two of the studies showed that healing of JOCD is slow, but the healing potential is higher than 50%. (Gebarski & Hernandez 2005, 882; Wall et al, 2008). One study (Krause et al. 2013, 2661) demonstrated a healing rate of 66% after conservative treatment. Based on the studied articles can be concluded that conservative treatment for stable juvenile osteochondritis dissecans knee lesions is justified. Also, early treated JOCD has higher rate of spontaneous healing.

CONTENTS

1 INTRODUCTION

The popularity of team sports in Finland is growing pregressively, especially among young people (Leppänen, Pasanen, Kujala & Parkkari 2015, 173). For example, a 2011 report on Physical activity and fitness of Finns in 2010 shows how youth participation in sports groups has incrades during last two decades (Husu, Paronen, Suni & Vasankar 2011, 20-23).

On the other hand, training intensively in early age may increase the risk of developing overuse injuries in young athletes, which are common in endurance and technical sports with long repetitive movement patterns (Leppänen, Pasanen, Kujala & Pakkari 2015, 173). Knee osteochondrositis dissecans is one of these common injuries that occur. Overuse injuries in adults mostly occur in tendons, muscles and ligaments due to the fact that they are weaker than bone. Overuse injuries in children occur mainly in the osteochondral region, because the epiphyses of immature skeletal structures are mechanically weak and mechanical forces like compression, shear and traction can cause osteochondrosis. (Naoto et al. 2014, 369-370)

The purpose of this thesis is to clarify juvenile knee osteochondritis dissecans (JOCD) and find out if conservative treatment is useful in stable JOCD and to conduct a systematic literature review. The thesis will review and analyze previous studies on the matter to determine the healing rate of stable juvenile knee osteochondritis dissecans (JOCD) lesion with conservative treatment. The research question of this systematic review is: What is the healing potential of stable JOCD with conservative treatment?

There are lack of studies and different understandings of JOCD lesions, which renders descision making complicated. Meanwhile if it is left undiagnosed, there is a bigger chance of osteoarthritis and other knee joint problems in the future (Pope, Bloem, Beltran, Morrison & Wilson 2014, 400).

2 KNEE JOINT

The knee joint is the most complex and biggest joint in the body. Also, the knee joint is considered a very mobile joint as it allows numerous movements: flexion, extension, small medial rotation and lateral rotation in flexion. As it is mobile and weight-bearing joint, it also is has a bigger risk to be injured. (Tortora & Derrickson 2012, 316-319)

2.1 Anatomy of the knee joint

The knee or tibiofemoral joint is the largest joint in the body. It consists of three joints: tibiofemoral joint on the lateral side, another tibiofemoral joint on the medial side and patellofemoral joint. (Tortora & Derrickson 2012, 316)

The knee joint (Figure 1) is formed by three bones, which all work together – the femur above the joint, the femur below and the knee cap (patella) in front of the joint. Tibiofemoral joint carries tensile forces caused by the quadriceps to the patellar tendon, and increases lever arm of the extensor mechanism. Patellofemoral joint carries body weight from femur to tibia. (Website of OrthoBullets, 2017)

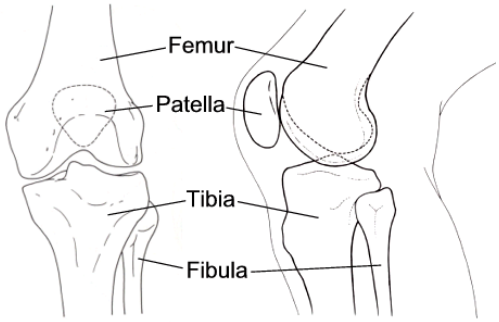


Figure 1. Knee joint. (SlideShare, 2014)

Extensors (Figure 2) of the knee joint are quadriceps femoris and tensor fascia latae. Quadriceps femoris is a group of four muscles: rectus femoris, vastus medialis, vastus lateralis, vastus intermedius. Flexion movement is controlled by the hamstrings (biceps femoris, semitendinosus, semimembranosus), popliteus, gracilis and sartorius. (Tortora & Derrickson 2012, 433)

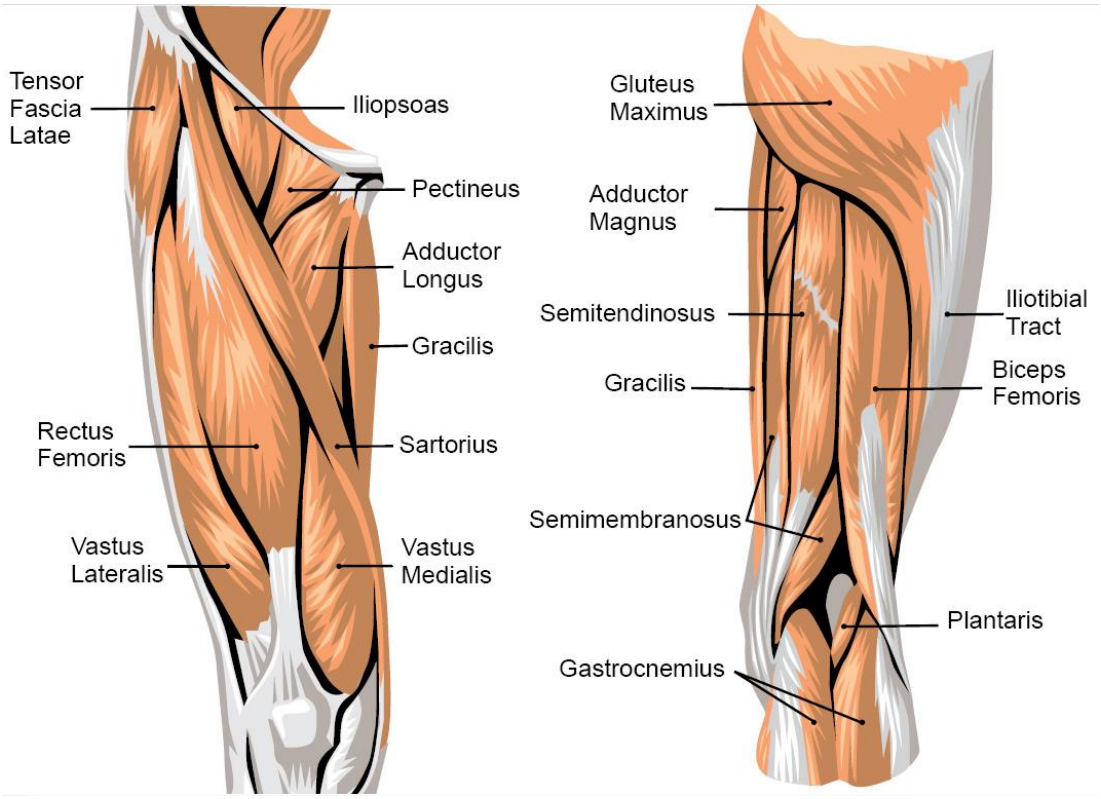


Figure 2. Anterior and posterior superficial view of thigh and knee. (Klejonka.info 2017)

The strength of the quadriceps muscle is one of the factors that affects the knee joint functions. It shows that lower extremity strength has a huge role to play in knee during weight-bearing activities. There is an increaed risk of progression of disease due to uncontrolled or big loading on the knee joint. (Anwer & Alghadir 2014, 745)

2.2 Biomechanics of the knee

Knee function is a balanced interaction between mechanical (static and dynamic) and biological factors. Static factors are alignment of the segments, surface geometry of bones and joint looseness. Dynamic factors consist of distribution of load during gate, which is influenced by proprioceptor feedback and neuromuscular control mechanisms helping to control force levels in the joint. Biological factors may be mixed with the effects of mechanical factors. (Cooke, Scudamore & Greer 2000, 98)

The tibiofemoral joint is a hinge-like joint, with sagittal plane joint rotation and a small degree of tibial axial rotation. Functionally, the quadriceps muscle groups and patel-lofemoral joint, together with the tibialis anterior and ankle joint, act to reduce forward

momentum when the body enters the stance phase of the gait cycle. (Flandry & Hommel 2011, 82) The full range of motion of the knee is 160 or more degrees flexion-extension (Cooke, Scudamore & Greer 2000, 98).

The patellofemoral joint bears up to 2-3 times body weight when going down the stairs and up to 7 times body weight when squatting. The tibiofemoral joint takes 3 times the body weight when walking. (Karadsheh)

The fundamental motor unit of the extensor mechanism is the quadriceps muscle group. The m. vastus lateralis creates about 50% of the bulk of the entire quadriceps muscle group. Figure 3 shows a balance mass and a geometric angle of insertion to the anatomic axis of femur apply an influence on patellar stability. (Flandry & Hommel 2011, 82)

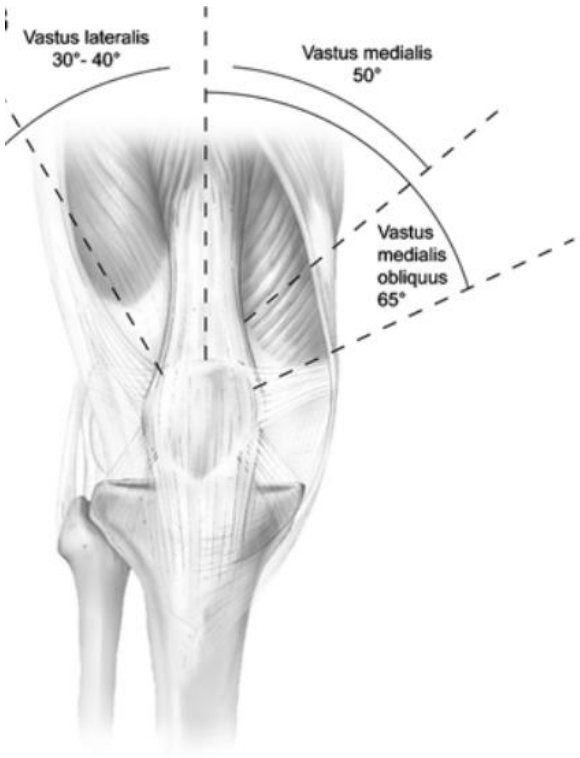


Figure 3. The major heads of the quadriceps muscle group (Flandry & Hommel 2011).

3 JUVENILE OSTEOCHONDROSIS DISSECANS (JOCD)

The term “osteochondritis dissecans” was first used by German surgeon Franz König already in 1888 to describe the existence of loose bodies in joints (O’Connor, Palaniappan, Khan & Bruce 2002, 258). Osteochondritis dissecans is mostly found in the knee (Figure 4), ankle and elbow joints. It has been thought that repetitive micro trauma may disturb the tenuous epiphyseal blood supply in the growing child, contributing to the development of osteochondritis dissecans lesions. (Marlovits, Singer, Resinger, Aldrian, Kutscha-Lissberg & Vecsei 2004, 25)

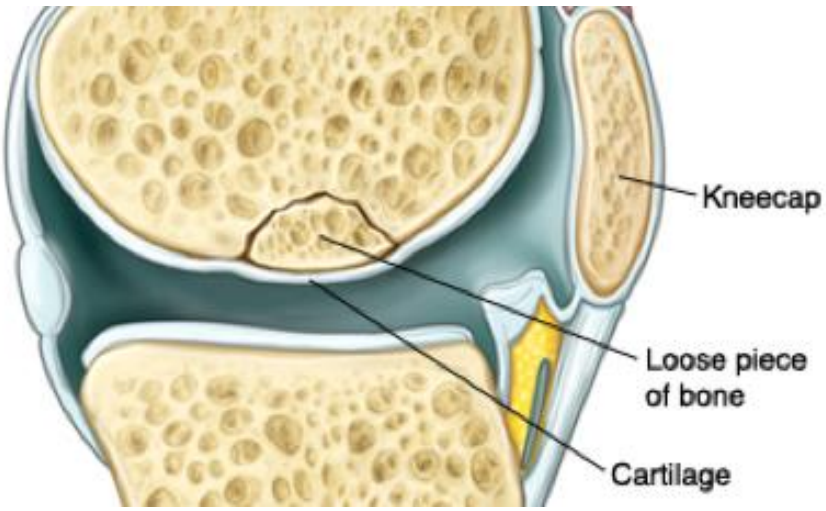


Figure 4. Knee osteochondritis dissecans. (Website of Canberra Orthopaedics and Sports Medicine 2017)

According to Hixon & Gibbs (2000, 151-156) osteochodritis dissecans mostly affects young physically active adolescents between the age of 10 to 20 and therefore the term juvenile osteochondritis dissecans is used. Simply there are two main types of osteochondritis dissecans (OCD): adult form, which occurs when physis closes and the juvenile form, which occurs in patients with an open epiphyseal plate.

3.1 Prevalence of JOCD

Data of JOCD is lacking. Most recent JOCD research done in England analyses hospital episode statistics from 2002-2010. Rate for hospitalized JOCD cases was small - 1.58 per 100,000 population. Young male patients were 50% more affected than young

female patients. (Keenan, Turner, Yeates & Goldacre 2014, 497) According to another study male patients had a much greater frequency of JOCD and almost 4 times the risk of JOCD compared with female patients (Kessler, Nikizad, Shea, Jacobs, Bebchuk, Weiss 2014, 320). Equivalent results are published by D`Agnelo, Kim & Murngham (2014) who reported ratio of 5:3 male to female patients. However, during past years knee JOCD cases in female population has increased, at the same time the mean age of patients has decreased (D`Agnelo, Kim & Murngham 2014, 388). One study noted that the highest incidence of JOCD in the United States is seen in the African American population (Grimm, Weiss, Kessler & Aoki 2014, 181).

Most, about 80-85%, of osteochondritis lesions in the knee are found in the medial femoral condyle area. The most often affected area of the medial condyle is the lateral aspect. (Pope, Bloem, Beltran, Morrison & Wilson 2014, 400) "This is probably due to microinjuries caused by repetitive impingement of the intercondyloid eminece against the medial condyle during internal rotation of the tibia" (Pope, Bloem, Beltran, Morrison & Wilson. 2014, 400). A lot of researchers suppose that the adult form is undiagnosed continuing juvenile OCD (Hixon & Gibbs 2000, 151-156).

3.2 Reasons for JOCD

The cause of JOCD may be repetitive microtrauma, ischemia, genetics, endocrine factors, and anomalies of ossification (Pill, Ganley, Flynn, Alden Milam, King & Gregg 2001, 25). However, D`Angelo, Kim & Murnaghan (2014) stated that the cause of JOCD is not clear by the fact that many theories have tried to explain the cause of JOCD of the knee, but there is poor evidence to support a single etiology. Still, currently there is general acceptance that the main cause is repetitive microtrauma due to the increasing prevalence of JOCD in young athletes, but the exact description of the mechanism is unknown (D`Angelo, Kim & Murnaghan (2014, 389).

In 1999 the European Pedriatic Orthopedic Society examined 509 JOCD lesions in 452 knees. The multicenter study showed that about 55% of young JOCD patients were regularly active in sports on demanding level. (D`Angelo, Kim & Murnaghan 2014, 389)

3.3 Symptoms

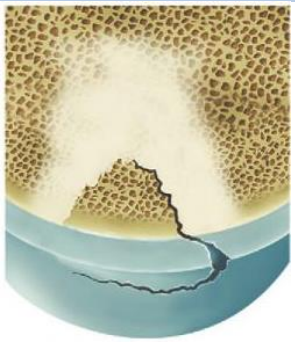
According to DiFiori et al. (2014, 13) symptoms like joint pain, swelling, limited range of motion and mechanical symptoms are common to OCD, patients usually complain of activity-related pain that develops gradually. Also, complaints often include catching, locking, and "diving away" (Pill, Ganley, Flynn, Alden Milam, King & Gregg 2001, 25). Patient with OCD might walk with affected leg rotated outwards to avoid tibial spine impingement. Otherwise there is no notable pathologic gait or typical symptom in alignment associated with OCD. (Pill, Ganley, Flynn, Alden Milam, King & Gregg 2001, 26)

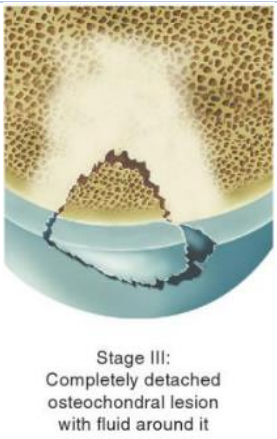
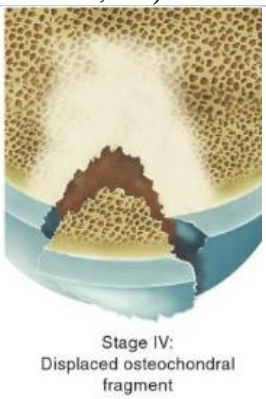
3.4 Classification

The prognosis of OCD often depends on the status of the growth plate. The juvenile form of OCD occurs in children with open growth plates. Although the name osteochondritis dissecans implies an inflammatory condition, the lack of inflammatory cells in histological examination suggests that there is a more likely cause. (Pill, Ganley, Flynn, Alden Milam, King & Gregg 2001, 25) Table 1 shows how osteochondritis dissecans can be classified according to lesions.

Table 1. Stages of osteochondritis dissecans ([1]Pope, Bloem, Beltran, Morrison & Wilson. 2014, 405; [2]Hixon & Gibbs. 2000, 151-156)

Stage	**MRI**	**Artroscopic**	
I	Bone marrow edema[1], Thickening of articular cartilage and low signal changes (stable)[2]	Cartilage intact but soft and ballotable[1]	 Picture 1. Osteochondritis Dissecans (Pope, Bloem,

			Beltran, Morrison & Wilson 2014, 405)
II	Articular cartilage breached[1], high-signal changes behind fragment and underlying subchondral bone (unstable)[2]		
IIa	Sunchondral cyst formation[1]	Stage-II Lesion showing early separation with interrupt of the cartilage[1]	 Stage IIa: Subchondral cyst formation Picture 2. Osteochondritis Dissecans (Pope, Bloem, Beltran, Morrison & Wilson 2014, 405)
IIb	Incomplete separation of the osteochondral fragment[1]		 Stage IIb: Partially detached osteochondral lesion with bone marrow edema Picture 3. Osteochondritis Dissecans (Pope, Bloem, Beltran, Morrison & Wilson 2014, 405)

III	Fluid around an undisplaced osteochondral fragment, Articular cartilage breached[1], high-signal changes behind fragment and underlying subchondral bone (unstable)[2]	Partially detached lesion[1]	 Picture 4. Osteochondritis Dissecans (Pope, Bloem, Beltran, Morrison & Wilson 2014, 405)
IV	Displaced osteochondral fragment[1], Loose body (unstable)[2]	Crater with loose bodies[1]	 Picture 5. Osteochondritis Dissecans (Pope, Bloem, Beltran, Morrison & Wilson 2014, 405)

4 TREATMENT

Treatment of osteochondritis dissecans is based largely on the stage of the lesions (Berrsche & Schmidt 2015, 278). Figure 5 shows the treatment process of OCD. Stable (phases 1-2) OCD lesions are usually treated conservatively, while phases 3-4 need surgical intervention. Early treated OCD has a higher rate of spontaneous healing. (Pope, Bloem, Beltran, Morrison & Wilson 2014, 400)

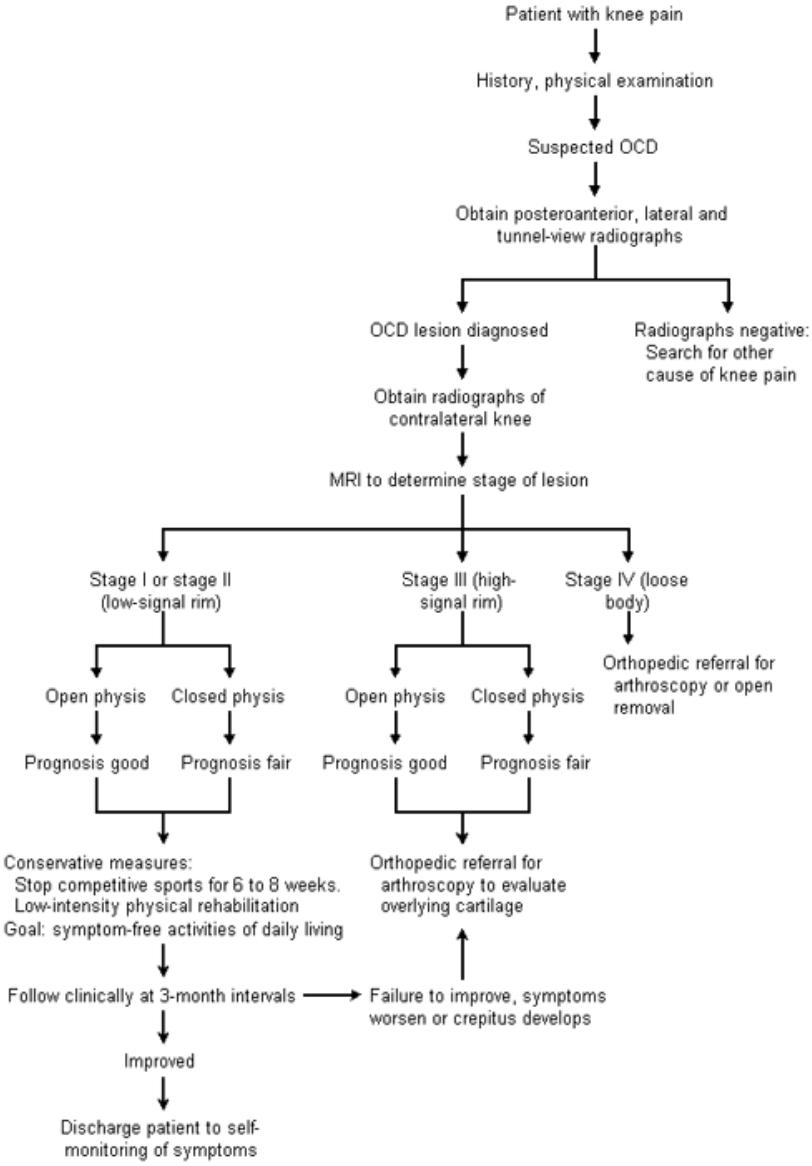


Figure 5. Management of OCD of the knee, algorithm for determination of the appropriate management of osteochondritis dissecans of the knee. (American Family Physician Online, 2000)

Stable OCD lesions cause little further damage to the lesion or to the remaining articular cartilage. Conservative treatment may vary from activity adjustment to limitation of weight-bearing. Given restrictions or adjustments should last until patient has no more symptoms. (Detterline, Goldstein, Rue & Bach 2008, 108-109)

There are many researches, variety of statistics and results of surgical treatment for OCD lesions, but similar information about non-operative treatment is lacking. Many researchers have found that JOCD is not commonly studied, and is left undiagnosed. (D`Angelo, Kim & Murnaghan. 2014, 388) Early diagnosis of OCD

means it can be treated conservatively, with the possibility of full recovery. If left undiagnosed there is an increased chance of osteoarthritis and other knee joint problems in the future. (Pope, Bloem, Beltran, Morrison & Wilson 2014, 400)

4.1 Conservative treatment

Treatment for OCD is based largely on the stage of lesions. In the first stages, mainly conservative treatment is used. Stress from knee should be taken off for 4-6 weeks, crutches can be used for support - as it helps to prevent axial compressive load and spontaneous reperfusion, blood flow restoration is allowed. (Berrsche & Schmidt 2015, 275-282) Conservative treatment is more frequently successful if it is carried out before growth plate closure (Mestriner 2012, 556).

Marlovits, Singer, Resinger, Aldrian, Kutscha-Lissberd and Vecsei (2000) recommend activity modification, non-weight bearing with crutches, and knee immobilization with range of motion exercises.

D`Angelo, Kim & Murnaghan (2014) proposed the plan of rehabilitation management that also consisted of patient education together with activity modification, manual therapy and passive modalities - cryotherapy, laser therapy, soft tissue therapy, and graded knee mobilizations.

4.1.1 Cast and orthoses

According to some studies immobilization and activity restrictions are the base of conservative treatment, but also duration and timing should be taken into consideration. Cast, braces and knee immobilization used to be commonly applied, but during past years it has changed. (D`Angelo, Kim & Murgnaghan 2014, 392) Casts and orthoses support and immobilize the joint at the same time. Immobilization critics point out joint stiffness, quadriceps atrophy and degeneration of cartilage as possible negative outcomes due to immobilization. (Berrsche & Schmidt 2015, 275-282) Extended duration of cast immobilization is not recommended – it may end up causing increased stiffness, atrophy and poor lesion healing (Marlovits, Singer, Resinger, Aldrian,

Kutscha-Lissberd and Vecsei 2000, 30). ”Prolonged immobilization and restricted weight bearing can lead to increased stiffness, muscle atrophy, and cartilage degeneration, and thus is not considered appropriate treatment” (Detterline, Goldstein, Rue & Bach 2008, 109).

4.1.2 Muscle training

Physiotherapy is needed to improve mobility and strengthen stabilizing muscles of the knee joint, especially quadriceps and hamstrings. Muscle strengthening program should last 6-12 weeks (Berrsche & Schmidt 2015, 275-282). Emphasis should be on range of motion and strengthening exercises (Detterline, Goldstein, Rue & Bach 2008, 109). Light activities such as walking, swimming and cycling during first 3-4 months have showed positive results in treating JOCD (D`Angelo, Kim & Murnaghan 2014, 387).

As mentioned before, the strength of the quadriceps muscle affects the knee joint function (Anwer & Alghadir 2014, 745). According to Anwer & Alghadir (2014), who researched the effects of isometric quadriceps exercise on muscle strength, pain, and function in knee osteoarthritis, concluded that 5-week isometric quadriceps exercise program is beneficial in patients with knee osteoarthritis. After 5-weeks the mean (SD) the exercise group had significally better quadriceps strength (3.00) than control group (0.04). Moreover, the pain in experimental group reduced greatly. (Anwer & Alghadir 2014, 745) During 5-week period exercise group performed isometric quadriceps exercise, straight leg raise, and isometric hip adduction exercise. All the exerciseses were done for 5 weeks, 5 days a week and in sets of 10 repetitions. The sets of exercises progressed weekly: 1 set of exercises was performed twice a day for the 1st week, 2 sets twice a day during the second week and then 3 sets twice a day until the 5th week. They also recieved ultrasound therapy. (Anwer & Alghadir 2014, 746)

4.1.3 Activity restriction

Contact sports, and dynamic changes of directions (stop-and-go) movements, jumping and landing with load are still restricted. After the knee pain has vanished, competitive

sports should still be avoided for 6-8 weeks. Also, if there is no pain and the radiographically confirmed findings allow, gradual running, jumping, load-landing and sports-specific training is accetable. The transitions between the phases should be individually adjusted. (Berrsche & Schmidt 2015, 275-282) There are also other authors who agree that conservative management should focus on restricting sport and high-impact activities for 6-8 weeks (D`Angelo, Kim & Murgnaghan 2014, 392).

After 10-18 months of conservative treatment including the right amount of weight-bearing has showed positive outcomes in 50-67% of young patients. MRI after 4-6 months is normally taken to control bone reossification (Berrsche & Schmidt 2015, 275-282). After 4-6 months of treatment returning to sports is possible (D`Angelo, Kim & Murnaghan 2014, 387).

4.1.4 Outcome

About 50% of lesions resolve in 10-18 months with conservative treatment. Female patients younger than 11 years old and male patients younger than 13 years old have good chance to heal. Patients over than 20 years old have more likely lower healing outcomes and have bigger chance requiring operative treatment. (Hixon & Gibbs. 2000, 151-156)

Stable knee JOCD conservative treatment with non-weight bearing and knee immobilization with daily range of motion exercises with 6 weeks activity modification results in successful healing by 3-6 months in more than 90% of cases (Marlovits, Singer, Resinger, Aldrian, Kutscha-Lissberd and Vecsei 2000, 30).

4.2 Operative treatment

Operative treatment in skeletally immature patients should be considered if lesions are detached or in case of unresponsive conservative treatment (Kocher, Tucker, Ganley & Flynn 2006, 1186). The two most common techniques used in juvenile patients are transepiphyseal and transarticular drilling. Both techniques aim is revascularization and healing. Also arthroscopic transarticular drilling has been found

effective, but not in the cases where physeal closure has already started. (Kocher, Tucker, Ganley & Flynn 2006, 1187-1188)

4.2.1 Cost-effectiveness

Studies of cost-effectiveness have indreased rapidly since 1993. Cost-effectiveness analysis is a method used in health care to assess the costs for of different health interventions. (Jamison, et al. 2006, 40-42)

Demand for total joint arthroplasty is growing fast and this is one of the most successful surgical intervention in medicine (Bumpass & Nunley 2012, 274). From 1990-2002 the number of primary total knee arthroplasty increased from 129,000 cases to 391,000 casses annualy, which is about 300% rate increase per 100,000 people. Also, cost-effectiveness in total knee arthroplasty depends on the age of the patients – operative treatment is twice cost-effective for patients over 70 years have twice as patients under 70 years old. (Bumpass & Nunley 2012, 274-277)

5 THE PURPOSE OF THE THESIS

The purpose of this thesis is to find out how effective conservative treatment is in stable juvenile knee osteochondritis dissecans and to conduct a systematic literature review. The thesis will review and analyse previous studies to determine what the healing rate of stable JOCD lesions with conservative treatment is.
The research question of this systematic review is:

What is the healing potential of stable JOCD with conservative treatment?

6 LITERATURE REVIEW

Khan, Kunz, Kleijnen & Antes (2003, 118) stated that systematic reviews are key elements of evidence-based healthcare. “A review earns the adjective systematic if it is based on a clearly formulated question, identifies relevant studies, appraises their quality and summarizes the evidence by use of explicit methodology” (Khan, Kunz, Kleijnen & Antes 2003, 118).

The phases in literature review are the following:

1. Framing the question: specific and clear study question
2. Identifying relevant work: multiple resources, reasons for exclusions and inclusions should be recorded
3. Assessing the quality of studies
4. Conclusion/Summarizing the evidence: tabulation of study characteristics, quality and effects, use of statistical methods
5. Discussion/Interpreting the findings: issues faced, heterogeneity, recommendations, strengths and weaknesses. (Khan, Kunz, Kleijnen & Antes 2003, 118-121)

7 SEARCH STRATEGY

In this chapter, an overview of search strategy and selection of relevant studies are presented.

7.1 Search strategy

The database search was conducted 19.-21.12.2016 using search database PubMed, ScienceDirect (Journal) and EBSCO. The search was undertaken with osteochondritis dissecans as the main heading along with one of the following terms: AND knee, AND lesion, AND stable, AND conservative treatment, AND nonoperative treatment, AND

nonsurgical treatment, AND result, AND outcome, AND healing, AND juvenile, AND children, AND young athlete. The results are shown in Table 2.

Table 2. Database search

		PubMed	ScienceDirect (Journal)	EBSCO
Osteochondritis dissecans	AND knee	269	82	201
	AND lesion	16	22	461
	AND stable	9	2	7
	AND conservative treatment	6	2	5
	AND nonoperative treatment	5	1	11
	AND result	2	12	16
	AND outcome	15	13	26
	AND healing	12	1	12
	AND juvenile	64	15	63
	AND children	27	11	16
	AND young athlete	-	1	1
Total:		425	162	819

7.2 Study selection

Table 3 shows the study selection process and the reasons as to why some studies were excluded at various stages. The study selection was made using PRISMA (Preferred Reporting Items for Systemic Reviews and Meta-Analyses), which is evidenced-based set also for reporting in systematic reviews (Website of Prisma Statement 2009). After duplicates were removed, there was a total of 33 studies (see Appendix 1) which met

the criteria of being published from January 1st, 2000, available as a free full text, were in English and about human subjects. Reasons for exclusion of another 30 studies were if they were surgical, not realted to knee, or not juvenile study. In the end of this process three studies remained.

Table 3. The steps of database search

Identification	**Database search**			
	PUBMED	SD JOURNAL	EBSCO	
	n=425	n=162	n=819	
				Total n=1406
Screening	**Records excluded** (applied exclusion criteria: free full text, humans, English, published after 1st of January 2000) -394	-153	-800	
				Total n= -1347
	n=31	n=9	n=19	
				Total n=59
	Records after duplicates (-26) **removed** n= 33			
Eligibility	Articles assessed for eligibility, reasons for exclusion: surgical, not knee, not juvenile			

Included	**Studies included** n=3

7.3 Assessing the quality of studies

The search resulted in the selection of 3 articles. The level of evidence of two of the analyzed studies is 2, and the level of evidence of the third study is unknown. Rating system for the hierarcy for evidence is from 1-7. Level 2 means that evidence is obtained from at least one well-designed Randomized Controlled Trial (RCT) (Website of Ebling Library, 2016). ”A mechanism for determining which study designs have the most power to predict cause-and-effect. The highest level of evidence is systematic reviews of RCTs, and the lowest level of evidence is expert opinion and consensus statement” (Melynk & Fineout-Overholt. 2011, 577).

Specifically, as the Figure 6 shows, the level of evidence together with the quality of evidence shows the strength of the evidence, which provides the confidence that is needed to adjust clinical practice and increases the quality of outcomes (Melynk & Fineout-Overholt. 2011, 5).

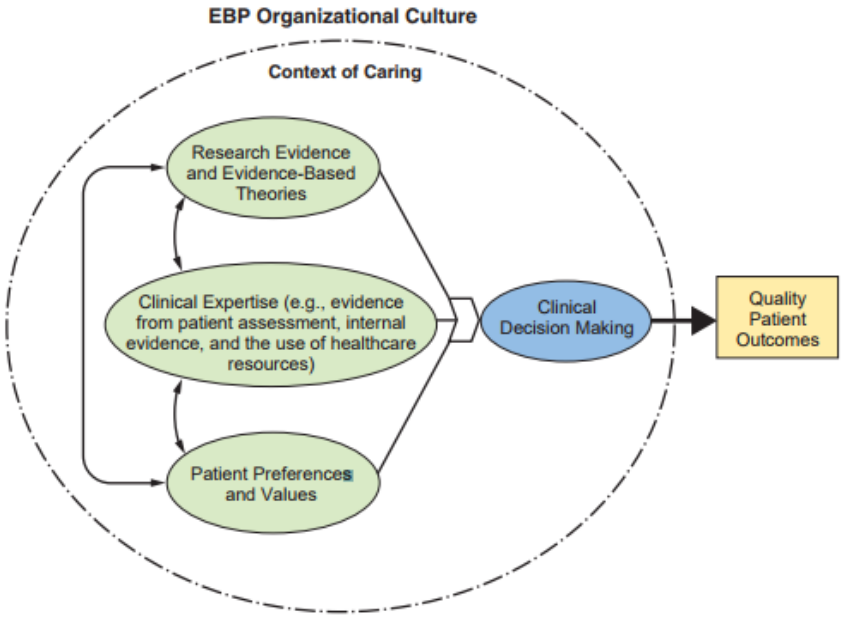


Figure 6. Evidence Based Practice (EBP). (Melynk & Fineout-Overholt 2003)

7.4 What is the healing potential of stable JOCD with conservative treatment?

The purpose of this review was to research the current evidence and find out what is the healing potential of stable JOCD with conservative treatment. As seen in Table 4, all three studies included in this review support the theory that JOCD healing without operation and treated consertively has a positive outcome.

Gebarski & Hernandez (2005) used radilogy reports from 1995-2003 for the study. They analyzed 23 patients in total (25 knees, 32 condyles) with stage-I JOCD. 16 of the patients were boys and 7 were girls at the age 7.5-17.7 (mean 13) years old. Follow up time was 17 months. Out of the 23 initial patients, 13 took part in the follow up tests. One part of conservative treatment included restriction of activity. Treatment results of these patients resulted with 54% healed knees – 7 patients (8 knees) were healed and no changes in 5 cases.

In a similar study Wall et al. (2008, 2655) investigated radiology reports from 1998-2005, and collected data from 42 patients (47 knees) – 32 male knees and 15 female knees. Temporary immobilization with knee bracing and activity restriction were used as treatment methods. Treatment was started with six weeks of weight-bearing immobilization with cast. After this, radiographs were taken and if they did not show

reossification of the lesion, the cast was used for another 4-6 weeks. Although, between the cast periods, a 3-7 day break was held to achieve full knee range of motion. After casting, osteoarthritis brace was used. After 6 months 66 % of the knees healed.

Krause et al. (2013, 1) conducted a cohort study and evaluated 62 patients (76 JOCD lesions) who came to the clinic in 2009-2012. If the patient had pain or mechanical symptoms, partial weight-bearing using crutches without limiting the range of motion was recommended. After four weeks of being symptom-free, the patient was allowed to increase weight-bearing, although repetitive-motion sports were restricted. Patient with no pain or other symptoms, and MRI showing healing progression, step-by-step return to normal activities was allowed. After 6 months 51 (67%) of 76 stable JOCD lesions showed no progression towars healing, and 33% showed signs of healing. Further, after 12 months 37 lesions (49%) had continued healing.

Table 4. Summary of the included articles

Title, author & year of publication	Study design	Data	Additional information & results of conservative treatment
Stage-I osteochondritis dissecans versus normal variants of ossification in the knee in children. Gebarski, K., Hernandez, R.J. 2005.	Level of evidence: unknown, not mentioned.	23 patients (25 knees, 32 condyles) 16 boys, 7 girls Stage-I JOCD Mean follow up time: 17 months (median 13 months; range 0,5-38 months) Mean age: 13 (7,5-17,7) Radiology reports from 1995-2003.	Restriction of activity 13 patients out of 23 had follow-up tests, 7 patients (8 knees) were healed, no change in 5 cases → 54% healed
Healing potential of stable juvenile osteochondritis knee lesions.	Level of evidence:	42 patients (47 knees) Female: 15 knees Male: 32 knees	Temporary immobilization followed by knee bracing and activity restriction.

Wall, E.J, Vourazeris, J., Myer, G.D., Emery, K.H., Divine J.G., Nick D.G., Hewett, T.E. 2008.	Prognostic level 2.	Radiology reports from 1998-2005.	Six weeks of weight-bearing immobilization in a cylinder or long-leg cast. If there was no signs of resossification after 6 weeks, the cast was piut back for additional 4-6 weeks. There was also a break in between for 3-7 days to regain range of motion of the knee. After 6 months: → 66% of knees healed
Healing Predictors of Stable Juvenile Osteochondritis Dissecans Knee Lesions After 6 and 12 Months of Nonoperative Treatment. Krause, M., Apfelmeier, A., Möller, M., Amling, M., Bohndorf, K. & Meenen N.M. 2013.	Cohort study (diagnosis). Level of evidence: 2.	62 patients, 76 stable JOCD lesions 2009 - 2012 diagnosed patients who came to a clinic	Partial weight-bearing with walking on crutches was recommended. After 4 weeks, if there were no symptoms, increasing weight-bearing was allowed. Pain-free swimming and biking was allowed. For patients without pain or mechanical symptoms full-loading was allowed, but repetitive-impact sports were restricted. Patient with no symptoms and MRI showed healing of the OCD lesion, then the patient could gradually return to all activities. After 6 months: 51 (67%) of 76 stable JOCD lesions showed no progression toward healing or showed signs of instability → 33% signs of healing After 12 months: → 37 lesions (49%) had progressed toward healing

8 CONCLUSION

Three different studies analyzed showed the healing rate of knees: one analyzed knee condyles, one knees and third one lesions. All these three studies showed that stable JOCD healing has positive outcome, but it takes time. Two out of three studies showed that healing potential of JOCD is higher than 50% after 6 months of conservative treatment. One out of three studies demonstrated the increased healing rate after 12 months of conservative treatment – 66% of knees healed. Conservative treatment for stable juvenile osteochondritis dissecans knee lesions is justified. Early treated JOCD has higher rate of spontaneous healing.

More studies in this area are required, data of OCD is lacking. Also, diagnosing JOCD is complicated and some researchers find that knee JOCD is underdiagnosed.

9 DISCUSSION

A big part of physiotherapy is rehabilitation, but prevention cannot be dismissed either. The reason I chose this as my topic to investigate was due to the interest to figure out why a lot of active young people have knee pain. Through reading literature and trying to find answers to my question I ended up researching knee JOCD and tried to find out how effective is conservative treatment is in knee JOCD cases.

To begin with, at first it was hard to narrow the topic, because there is a lot of information and all of it seemed to be important. Once I formuled and focused more on my study question, it was possible to eliminate information irrelevant to my study. Gathering the data was time-consuming, but the process itself ended up being very interesting. I found setting up inquiry search criteria the most important. Also, strict

criteria it made exclusion of studies easier. However, i still tried to be critical while reading various articles.

Secondly, through the search criteria, only three studies remained, which was expected since in the beginning of narrowing the thesis topic, it was not easy to find reliable background information. Moreover, these three studies all were specified on JOCD and results were presented similarly even though there were differences how they collected data – two studies analyzed radiology reports and one sudy evaluated patients who came to their clinic. All three studies researched knee JOCD, but also there were small variations - one analyzed knee condyles, one knees and third one lesions. Based on the results, all three studies included in this review support the theory that JOCD healing without operation and treated consertively has a positive outcome.

Thirdly, I found interesting that even though JOCD is under-researched and the specific cause is unknown, all three studies had similar understandings about JOCD. Therapy methods used in all three studies consisted activity restriction, which was also pointed out in theory part. Also, all three studies were published in different years: 2005, 1008 and 2013 – it also gave nice overview how believes and treatments have changed over time. Gebarski & Fernandes (2005) mentioned only activity restriction, but research done by Wall et al. (2008) immobilization, knee cast and bracing was added to activity restriction. In theory part appeared that some researches do not recommend immobilization any more due to negative outcomes. Instead, in Krause et al. (2013) study instead of mobbilization walking with crutches without limiting the range of motion was recommended.

Some limitations need to be recognized in this review. Two out of three studies analyzed radiology reports from different period of time, which may be analyzed differetly and give dissimilar results due to the development of technology and method. Moreover, treatment process in JOCD cases is long and it is impossible to control patients constantly, so it is impossible to say if they all followed recommendations like activity restriction.

From the research I gathered, two of the studies levels of evidence was 2, but third study level of evidence was not mentioned. It could be argued that this decreases the

reliability of the results. On the other hand the methods of this one were very similar to one of the studies, which had evidence level 2. Moreover, all three articles had different authors and publication time, which provides greater validity.

The fact that JOCD is under-researched was mentioned few times – seems that is also an issue why the awareness of JOCD is low and why it is left undiagnosed. Furthermore, if left undiagnosed there is an increased chance of osteoarthritis and other knee joint problems in the future. This topic needs further studies and more fixed definitions.

As the purpose of this thesis is to find out is conservative treatment useful in stable JOCD, the focus was to find an answer to this specific question. Further studies could investigate and compare juvenile and adult osteochondritis dissecans, analyze the lesion locations and the types of osseous defects.

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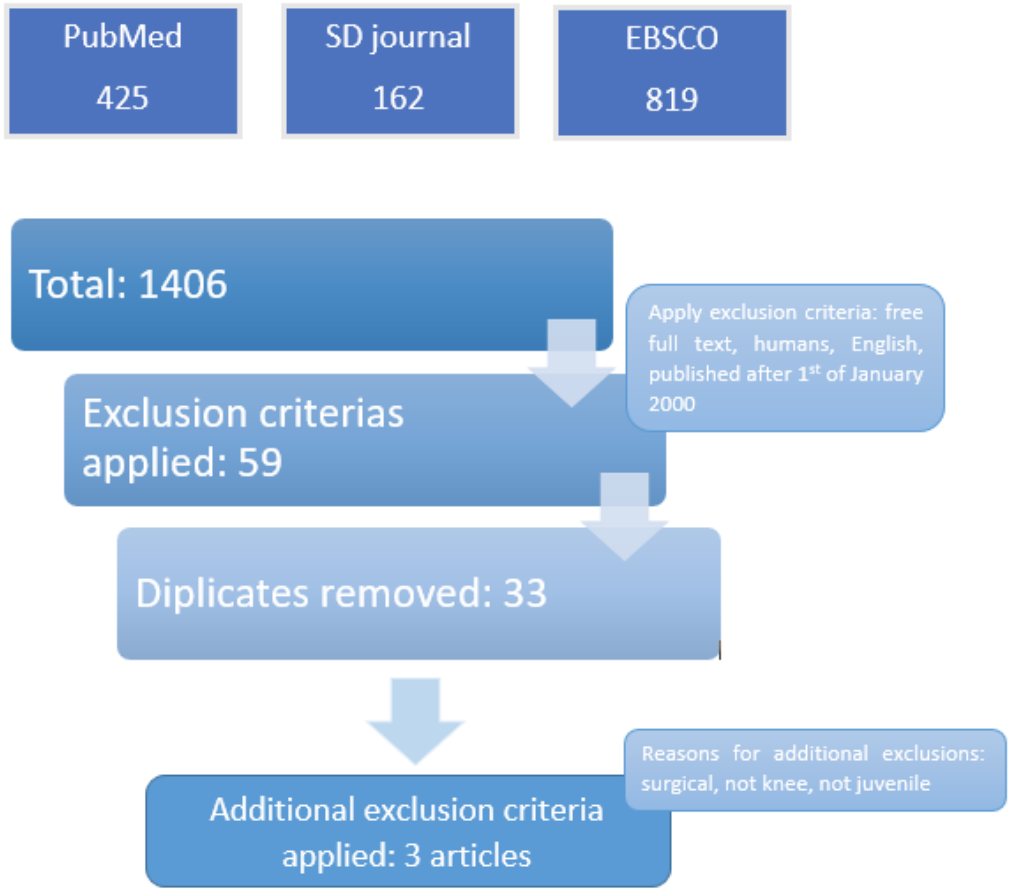
APPENDIX 1



Flow diagram of study selection